A NEW MERCURY VAPOR LAMP FOR LABORATORY USE*

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For a number of years there has been a considerable demand for a mercury vapor lamp as a source of bright line spectra or monochromatic radiation to be used in the general or research laboratory. The mercury vapor lamp in quartz is an excellent source, but its expense is often prohibitive. Large mercury lamps in glass, designed for industrial illumination, are very cumbersome and of such low intensity that the red lines can hardly be observed with a small spectroscope. The small arc lamps found in some of the laboratories have, as a rule, a very short life and are unstable in operation.

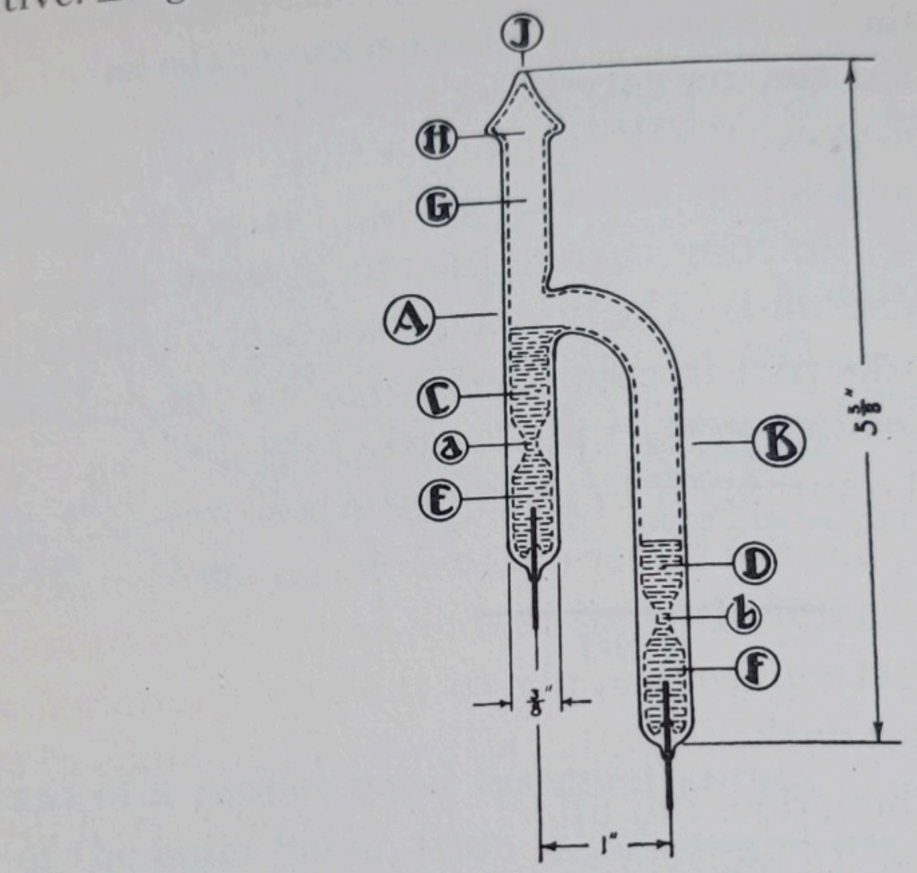

Fig. 1. *Mercury vapor lamp of new design with constricted terminals.*

An ideal lamp must fulfill the following requirements: (1) simplicity of construction, (2) compactness, (3) ease of starting, (4) steady operation, (5) high intensity, (6) long life. The following is a description of a mercury lamp that meets all these requirements remarkably well.

The mercury vapor lamp as shown in Fig. 1, consists of a straight Pyrex tube, *A*, with a branch tube, *B*. The upper portion of the straight

* Arrangements have been made with the Central Scientific Company of Chicago, for the manufacture and sale of these lamps.

tube serves as a condenser, G. The lower legs, CE and DF, are filled with mercury and have tungsten sealed-in electrodes. The inner ends of the wires lie below the constricted passageways, a and b, which are small enough to retain the mercury in E and F, when the lamp is tilted. The flare, H, serves as a support. After pumping for ten minutes with a Cenco Hyvac pump the lamp is sealed off at J. During the period of evacuation the lamp is heated with a Bunsen flame to drive off occluded air and water vapor.

The lamp should be operated on direct current of 60 to 120 volts. A suitable ballast resistance is necessary to maintain a current of about one ampere at 35 volts across the terminals. In starting, a part of the ballast is cut out and the lamp tilted out of the plane of the paper along a horizontal axis, so that the mercury lying above the constricted passageways, a and b, runs over into the condenser tube. The lamp is then returned into a vertical position and the excess of mercury spills over into D, striking the arc. Starting current should be kept at three amperes for at least thirty seconds. The discharge takes place between the two levels of mercury, the part in column B providing the main source of radiation. It is also possible to start the lamp by tilting it in a counterclockwise direction and returning it to the upright position.

The choice of polarity for the upper or lower terminal does not affect the character of the discharge. It is advisable, however, to connect the positive side of the direct current supply to the upper terminal where the glass usually becomes darkened after a few hundred hours of operation. This blackening, then, does not affect the straight part of the tube from which light is taken. In operation the mercury vapor condenses in G from which it drops down to C. Any excess of mercury accumulated at C spills over into D, thus maintaining a constant level in both terminals.

The constrictions a and b, which are important features of this lamp, serve to retain mercury in the pockets surrounding the tungsten electrodes so that, on striking the arc contact is made between mercury and mercury, thus preventing sudden heating of the tungsten terminals which might crack the seal, or vaporize the metal and blacken the walls of the tube, thereby decreasing the intensity of the source. Another advantage of the constrictions is that the transmission of heat from the mercury at the arcing surface to the sealed terminal, both by conduction and convection is greatly reduced. In operation the lower terminal is not uncomfortable to the touch.

For convenience of operation the lamp may be mounted in the housing shown in Fig. 2. It consists of a brass tube, *A*, 3 1/4 in. in diameter and 7 in. long which can be clamped to a tripod by means of an extension rod *B*. The lamp is placed so that the discharge column is situated behind the slit, *C*, whose width is controlled by a knurled nut, *D*. This controllable slit is made in the following way. The brass tube is cut perpendicular to its axis at two planes 1 1/8 in. apart leaving uncut about an inch and a half behind the tube. The front part is then slotted and a screw extending along the diameter varies the width of the slit

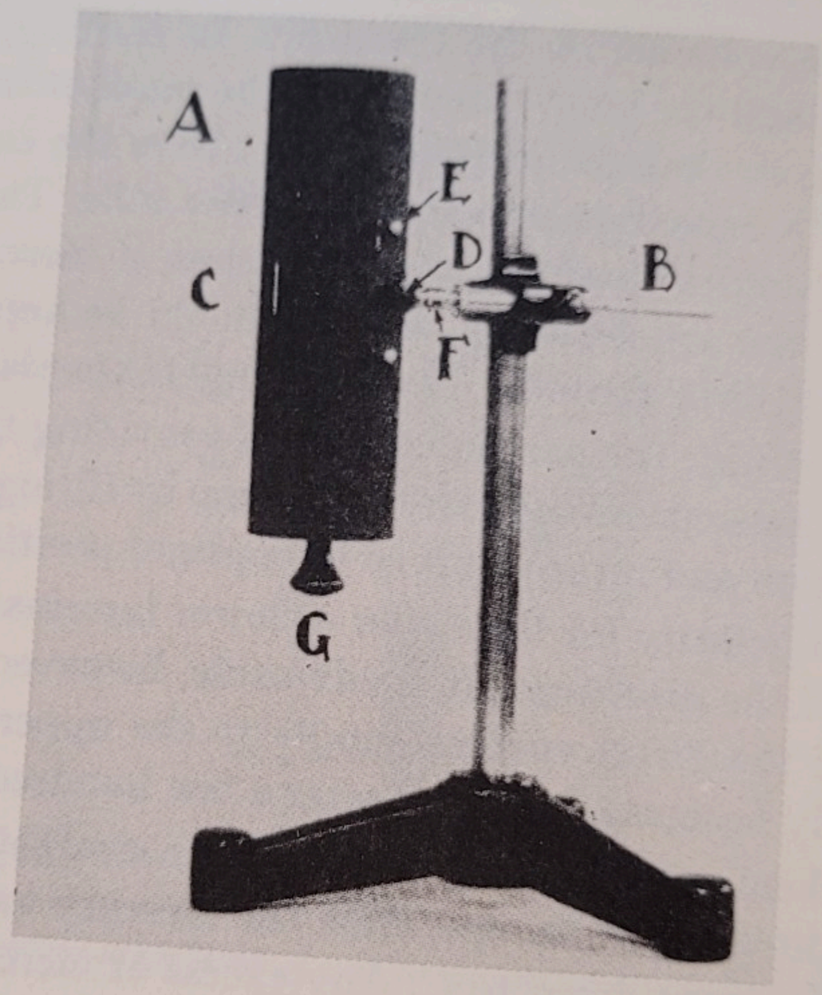

FIG. 2. *Housing for mercury lamp with a slit of variable width.*

from zero to 3/8 of an inch. In order to prevent light from coming through the horizontal slots two cylindrical shutters are placed inside the tube. These can be moved up and down by means of four studs, *E*, (the other two studs are on the opposite side) which control the height of the slit. A metal strip clamped around the condenser, *G*, Fig. 1, and fastened to the inside of the housing holds the lamp rigidly in place. Two binding posts, *F*, located at the back of the tube serve for terminal connections. A handle, *G*, used for tilting the tube, is connected to a light lock which allows air to pass through for ventilation, yet shuts off the light.

In actual practice it has been found that the lamp meets all the requirements stated in the beginning. Figs. 1 and 2 suffice to show simplicity and compactness. The vertical position of the discharge tube is of a special advantage for spectroscopic work. The lamp usually starts at the first tilting and maintains a steady current practically indefinitely. The intensity is sufficiently high to observe at least twenty lines in the visible spectrum through a small spectroscope of the type generally used in elementary laboratory. Two lamps on life test have been burning for more than four thousand hours without serious blackening of the tube.